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(54) Arrangement for fire fighting

(57) A method and an apparatus for punching a piercing tool through a wall shell structure and for feeding fire-retardant medium to the object on fire. At the outermost end of the rescue boom (3) there is a piercing device (6), which comprises an elongated piercing tool (7). The piercing device (6) comprises an actuator for punching the piercing tool (7) through the shell structure (8) by a longitudinal movement (8). The actuator comprises at least one spring member (34) for providing a longitudinal impact.

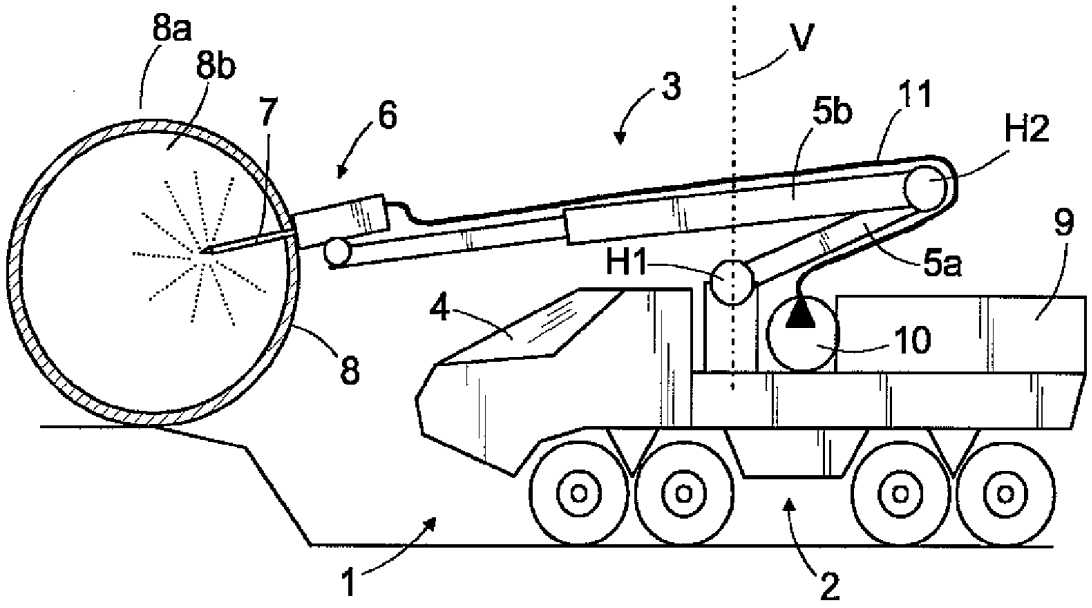

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a method of feeding fire-retardant medium from a first side of a wall shell structure to a second side thereof, the method comprising: positioning a rescue boom adjacent the first side of the wall structure; piercing the wall structure by punching by a rapid longitudinal movement at least a portion of an elongated piercing tool provided on the rescue boom from the first side of the wall structure to the second side thereof by operating an actuator provided in operative engagement with the piercing tool; maintaining the boom substantially stationary during the piercing step; and feeding the fire-retardant medium through at least one longitudinal channel provided in the piercing tool and through at least one nozzle connected to the channel to the second side of the wall structure.

[0002] The invention also relates to a rescue boom comprising: a movable boom, which comprises a proximal first end, which is connectable to a carrier, and a distal second end; at least one piercing tool disposed adjacent the second end of the boom, the piercing tool being an elongated member having at least one longitudinal channel, the position of the piercing tool with respect to the second end of the boom being adjustable; at least one feed channel for feeding fire-retardant medium into the channel of the piercing tool; at least one nozzle, which is connected to the longitudinal channel of the piercing tool and through which the fire-retardant medium is arranged to be fed; and at least one actuator for moving the piercing tool in its longitudinal direction with respect to the second end of the boom.

[0003] The invention further relates to the piercing device comprising: at least one piercing tool, which is an elongated member comprising at least one longitudinal channel; at least one feed channel for feeding fire-retardant medium into the channel of the piercing tool; at least one nozzle, which is connected to the channel of the piercing tool and through which the fire-retardant medium is arranged to be fed; at least one actuator for moving the piercing tool in its longitudinal direction.

BACKGROUND OF THE INVENTION

[0004] In fire fighting, it is very important to start fire-fighting measures promptly before the fire expands so that it cannot be controlled. In the case of an air crash, for example, the fire should be brought under control within the first few minutes from the onset of fire. In that case the fire-fighting equipment should be brought to the scene as fast as possible and the fire-retardant medium has to be quickly fed inside the object on fire without having to break down the structures. Thus rescue booms have been devised that are placed on a movable carrier and provided with a piercing tool, which can be pushed through the wall structure of the object on fire. The piercing tool with a sharp point pierces the body structures of vehicles and the like relatively easily. After piercing, fire-retardant medium can be fed directly into the object on fire. In the existing apparatuses piercing is carried out by moving the boom parts with respect to their joints or by extending telescopic boom parts. A problem associated with taking the piercing tool through the wall structure using conventional boom movements is that it is difficult for the user to control the boom to achieve the necessary piercing movement. Furthermore, the user does not sense the movements of the boom, for which reason he does not notice if forces are directed to the piercing tool that could damage it.

[0005] Prior art solutions are described in the following publications: US 5 211 245, US 5 301 756, US 5 788 158 and US 5 839 664.

BRIEF DESCRIPTION OF THE INVENTION

[0006] The object of the present invention is to provide a new and improved arrangement for taking a piercing tool used in fire fighting through a wall shell structure.

[0007] The method of the invention is characterized by punching the piercing tool through the wall structure by spring force.

[0008] The rescue boom according to the invention is characterized in that the actuator comprises at least one spring for providing a longitudinal impact by the piercing tool.

[0009] The piercing device of the invention is characterized in that the actuator comprises at least one spring member for providing a longitudinal impact by the piercing tool.

[0010] The basic idea of the invention is that the outermost end of the boom is provided with at least one piercing device, which comprises at least one elongated piercing tool. Furthermore, the piercing device includes an actuator for generating a longitudinal movement in the piercing tool for taking the tool through the wall shell structure that confines the fire without moving the boom. The actuator comprises at least one spring member for punching the piercing tool through the wall shell structure by a quick longitudinal movement.

[0011] An advantage of the invention is that the actual piercing is carried out by a separate actuator without moving the boom. Therefore, it is considerably easier and faster to carry out piercing than by moving a long boom. Furthermore, damage to the piercing tool can be avoided. Since the tool is punched through the wall structure, the forces needed in piercing are relatively small.

[0012] The basic idea of an embodiment according to the invention is that the front end of the piercing device is provided with a plunger, which is pressed by a predetermined force against the wall structure before piercing. This allows to avoid yielding of the wall structure due to the piercing forces. Furthermore, the plunger may locally deform the place to be pierced, which also facil-

itates the piercing.

BRIEF DESCRIPTION OF THE FIGURES

[0013] The invention will be described in greater detail in the accompanying drawings, in which

Figure 1 schematically illustrates a rescue vehicle equipped with a piercing device according to the invention,
Figure 2 is a schematic side view of the outermost end of a rescue boom according to the invention,
Figure 3 is a schematic top view of the outermost end of the rescue boom shown in Figure 2,
Figures 4 to 6 are schematic sectional views of a piercing device according to the invention in different situations,
Figure 7 is a schematic and sectional view of another piercing device according to the invention,
Figure 8 is a schematic and sectional view of the structure of the end of a piercing tool, and
Figures 9 and 10 schematically illustrate arrangements for positioning the piercing device of the invention with respect to the wall structure to be pierced.

[0014] For the sake of clarity, the figures illustrate the invention in a simplified manner. In the figures, like reference numbers refer to like elements.

DETAILED DESCRIPTION OF THE INVENTION

[0015] Figure 1 shows a rescue vehicle 1, which comprises an independently movable carrier 2, which may be an appropriate vehicle, e.g. an all-terrain vehicle similar to the one shown in Figure. Alternatively, the movable carrier may be a trailer or a ship. On the carrier 2 there is a rescue boom 3, which comprises at least one boom part, which can be moved with respect to the carrier 2. In the solution shown in Figure 1, the boom 3 is arranged behind the control cabin 4. The boom 3 includes a first boom part 5a, whose first end is connected to the carrier 2 so that the boom part 5a can be rotated about a vertical axis V. Furthermore, a horizontal joint H1 enables lifting and lowering of the second, i.e. the outermost, end of the boom part 5a. A second boom part 5b is connected to the outermost end of the first boom part 5a. The outermost end of the second boom part can be lifted and lowered with respect to a horizontal joint H2 between the first boom part 5a and the second boom part 5b. The boom parts 5a, 5b may be moved e.g. by pressure medium cylinders and motors or in another manner known per se. For the sake of clarity, the actuators needed to move the boom are not shown in Figure 1. The outermost end of the boom 3 comprises a piercing device 6, which includes an elongated sharp-pointed piercing tool 7 and means for punching the piercing tool 7 from the side of the first surface 8a of the wall structure 8 to the side of its second surface 8b. The carrier 2 is further provided with a container 9, which includes fire-retardant medium. Fire-retardant medium is pumped by a pump along a feed channel 11 to the piercing device 6. The feed channel 11 is connected to the piercing tool 7, which is provided with one or more longitudinal channels that can be used for feeding the fire-retardant medium to one or more nozzles of the piercing tool 7. The outermost end of the piercing tool 7 may be provided with one or more nozzles. The nozzles are arranged so as to achieve the desired spray pattern.

[0016] In the situation shown in Figure 1 the carrier 2 has been driven next to a fuselage, after which the piercing device 6 has been brought against the outer surface 8a of the fuselage by moving the boom 3. Then the boom 3 is kept stationary and the piercing is carried out by punching the piercing tool 7 through the wall shell structure 8 of the fuselage. After this, fire-retardant medium is fed into the space 8b defined by the wall structure 8 using the piercing tool 7. If necessary, the wall structure 8 is pierced several times. That is to say, that when the piercing of the wall structure is insufficient, the piercing tool may be punched several times until the proper piercing is achieved. The fire-retardant medium may be water, mist consisting of water and gas, fire foam, fire-fighting chemical, fire-fighting gas or another suitable solid, liquid or gaseous substance or a mixture thereof. After a necessary amount of fire-retardant medium has been fed, the piercing tool 7 is pulled out of the wall structure 8 by means of the piercing device 6, after which the piercing device 6 can be taken to a new location by moving the boom 3, and the piercing and the feeding of fire-retardant medium can be performed again. To avoid damage to the piercing tool 7, the boom 3 may be prevented from moving during the piercing.

[0017] Figure 2 illustrates the structure of the outermost end of a rescue boom 3. The boom 3 comprises means for adjusting the position of the piercing device 6 with respect to the boom 3. The means may comprise one or more joints 12, 13 with respect to which the piercing device 6 may be moved by suitable actuators so that the longitudinal axis of the piercing tool 7 is substantially perpendicular to the outer surface 8a of the wall structure 8 to be pierced. In that case it is not necessary to position the boom 3 accurately, but positioning can be performed quickly and easily by adjusting the position of the piercing device 6 with respect to the boom 3 end. By positioning the piercing tool 7 substantially perpendicularly to the outer surface 8a of the wall structure 8, cross-directional loads on the piercing tool 7 can be avoided. Furthermore, the piercing is effective since the piercing force is directed perpendicularly to the surface 8a of the wall structure. Figures 9 and 10 illustrate some arrangements for adjusting the position between the piercing device 6 and the wall structure 8 to be pierced.

[0018] As further appears from Figure 2, the outermost end of the boom 3 may be provided, in addition to the piercing device 6, with one or more lights 14, video

cameras or thermographic cameras 15 and different sensors 17, e.g. temperature sensors. Furthermore, the outermost end of the boom 3 may comprise one or more non-piercing nozzles 16 for feeding fire-retardant medium. The nozzle 16 and its support structure 18 may be arranged to turn together with the piercing device 6 with respect to the joint 12. In addition, the nozzle 16 may be arranged to turn by means of a joint 19 with respect to the support structure 18, in which case it can be turned sideways independently, as appears from Figure 3. The fire-retardant medium is supplied from the carrier 2 along a feed channel 20 to the nozzle 16. For the sake of clarity, Figure 3 does not show the auxiliary devices illustrated in Figure 2.

[0019] Figure 4 illustrates a piercing device 6 at a standstill where the piercing tool 7 is inside a casing 30. In the front of the piercing device 6 there is a plunger 24, which is pressed against the wall structure 8 to be pierced by moving the boom 3 in direction A. The plunger 24 may comprise pins 31 which are influenced by springs 25 and whose movement is detected by a detector 32. Alternatively, the plunger 24 comprises a compressible pressure space which contains pressure medium and whose pressure is monitored by a sensor. An actuator 33 belonging to the piercing device 6 is not charged until the sensor 32 detects that the piercing device 6 is pressed against the wall structure 8 by a predetermined force. Since charging and discharging require that a certain force act on the plunger 24, the piercing device 6 is safe to use. In addition, information can be transmitted from the detector 32 to the control unit of the device, which may prevent the boom 3 from moving after the plunger 24 has been pressed against the wall structure 8 by a pre-determined force. The actuator 33 comprises one or more spring members 34, e.g. coil springs, which are arranged to act on a cradle 36 by means of a push plate. The cradle 36 is connected to the piercing tool 7 and arranged to be moved by a pressure medium cylinder 38 using chains 37a and 37b or similar power transmission means. The cylinder 38 may be driven by pressure fluid or pressurized gas. The cylinder 38 is provided with idler wheels 39 and 40, around which the chains 37a and 37b are arranged. The first ends of the chains 37a and 37b are connected to the cradle 36 and their second ends are connected immovably to the frame of the piercing device 6. This structure enables generation of the necessary charging movement by a short movement of the cylinder 38.

[0020] When the plunger 24 is pressed against the wall structure 8 as shown in Figure 5, pressure medium is supplied to the first pressure space 41 of the cylinder 38 and thus the cylinder 38 moves to the left, in direction B. In that case the chain 37a draws the cradle 36 to the left, and thus the cradle 36 presses the springs 34 together by means of the push plate 35, thus charging the actuator 33 for the impact. The amount of the impact energy can be adjusted by varying the number and properties of the springs 34 as well as the fact how much the springs 34 are compressed. Compression of the springs 34 can be monitored by a detector 42. When the desired compression has been achieved, a connection is opened from the pressure space 41 of the cylinder to a discharge channel, in which case the spring force pushes the cradle 36, the piercing tool 7 and the cylinder 38 towards the front of the piercing device 6 in direction C by a rapid impact-like movement. This situation is illustrated in Figure 6. The sharp point of the piercing tool 7 pierces the wall structure 8, allowing the tool 7 to penetrate to the side of the second surface 8b of the wall structure 8.

[0021] If the piercing tool 7 does not for some reason pierce the wall structure 8 properly due to the impact, pressure medium can be fed to the second pressure space 43 of the cylinder 38 and the cylinder 38 can press the piercing tool 7 in direction C. After the piercing has been carried out and the fire-retardant medium has been fed, pressure medium is supplied to the first pressure space 41 of the cylinder 38, in which case the cylinder 38 draws the piercing tool 7 back inside the casing 30 of the piercing device 6.

[0022] Figure 7 illustrates a piercing device 6 where the piercing tool 7 is moved by an actuator 33 driven by pressure medium. The actuator may be a hydraulic or a pressure medium cylinder 44, whose piston rod 45 is connected to the piercing tool 7 by means of a pusher 46. The actuator 33 can be driven by supplying a high and sudden pressure medium flow from a pressure accumulator or the like to the first pressure space 47 of the cylinder 44 and by directing a rapid impact-like movement to the piercing tool 7 in the longitudinal direction. Alternatively, the tool 7 can be pressed through the wall structure 8 by means of the cylinder 44 using a lower speed. There is a detector 32 at the front of the piercing device 6 for detecting the position between the wall structure 8 and the piercing device 6.

[0023] In addition to the solutions described above, the piercing tool 7 can also be moved by an electric actuator 33, such as a solenoid. Furthermore, the piercing tool 7 can be moved e.g. by a combination of a pressure operated or an electric motor and mechanical power transmission means. In addition, the impact energy for punching the piercing tool 7 through the wall structure 8 can in some cases be generated by a pyrotechnical actuator 33.

[0024] Figure 8 illustrates part of a piercing tool 7. The tool 7 comprises a longitudinal rod 48 provided with at least one channel 49 for feeding fire-retardant medium. The point of the piercing tool 7 may be provided with a detachable nozzle section 50, which can be replaced if it wears out. Different nozzle sections 50 where the number and direction of the nozzles 51 are different can also be produced. A desired spray pattern is achieved by changing the nozzle section 50. It is also feasible that the longitudinal channel 49 provided in the piercing tool 7 does not extend up to the point of the piercing tool 7 but a nozzle or nozzles are arranged in the rod 48 of the

piercing tool 7 close to its free end, as illustrated in Figure 7. At its simplest the nozzle 51 may be a bore extending from the channel 49 to the outer surface of the tool 7.

[0025] Furthermore, the piercing device 6 may comprise suitable attachment members by means of which it can be easily attached to and detached from different booms 3. Thus the piercing device 6 may be fixed to the boom 3 or it may be an auxiliary device, which can be arranged in the boom 3 when necessary.

[0026] Figure 9 illustrates a piercing device 6, which comprises at least two bars 21 extending a certain distance to the front of the piercing device 6. The bars 21 are connected to sensors 22, from which information is transmitted to the control unit of the apparatus. When the boom 3 is moved towards the wall structure 8 to be pierced, the bars 21 are first pressed against the wall structure 8. If the shaft of the piercing tool 7 is not substantially perpendicular to the wall structure 8, the bars 21 are not pressed evenly against the wall structure 8, which is detected by the sensors 22. An erroneous angular position can be corrected by turning the piercing device 6 with respect to the boom 3 end by joints 12 and 13. The control system may be arranged to automatically keep the piercing device 6 in the correct position to the wall structure 8, in which case it is easy for the user to bring the piercing device 6 in the correct position by moving the boom 3.

[0027] In Figure 10 the position between the piercing device 6 and the wall structure 8 is monitored by two or more proximity sensors 23. The proximity sensors 23 may be ultrasound transmitters/receivers, inductive sensors or other appropriate detectors, for instance.

[0028] The solution according to the invention may be applied in rescue operations involving various vehicles, such as aircraft, railway rolling stock, watercraft and road transport vehicles. The wall structures of vehicles usually comprise a relatively thin metal or composite shell, which can be pierced relatively easily by punching the piercing tool through the wall structure. The invention can also be used in fire fighting in various buildings since the piercing tool can be punched through most wall and roof structures. The piercing tool easily pierces at least wooden structures of buildings and metal-sheeted warehouses and industrial premises as well as tin, felt and tile roofs. Furthermore, the piercing tool can break or pierce the window of a building or vehicle. The invention is also applicable in piercing of various tanks, containers and the like.

[0029] The piercing tool may also be brought through only one shell structure of a wall, in which case fire-retardant medium can be fed inside the wall structure.

[0030] The drawings and the related description are only intended to illustrate the inventive concept. The details of the invention may vary within the scope of the claims. In some cases, one boom may be provided with several piercing devices of the invention. On the other hand, one piercing device may comprise several piercing tools. In addition, the rescue boom of the invention may be placed on a fixed base instead of a movable carrier.

Claims

1. A method of feeding fire-retardant medium from a first side of a wall shell structure to a second side thereof, the method comprising:

   positioning a rescue boom (3) adjacent the first side (8a) of the wall structure (8);
   piercing the wall structure (8) by punching by a rapid longitudinal movement at least a portion of an elongated piercing tool (7) provided on the rescue boom (3) from the first side (8a) of the wall structure to the second side (8b) thereof by operating an actuator provided in operative engagement with the piercing tool (7);
   maintaining the boom (3) substantially stationary during the piercing step; and
   feeding the fire-retardant medium through at least one longitudinal channel (49) provided in the piercing tool (7) and through at least one nozzle (51) connected to the channel to the second side (8b) of the wall structure (8),

   characterized by

   punching the piercing tool (7) through the wall structure (8) by spring force.

2. The method according to claim 1, **characterized by**

   punching the piercing tool (7) several successive times by spring force.

3. The method according to claim 1, **characterized by**

   pressing the piercing tool through the wall structure (8) by a pressure operated actuator provided on the boom (3) when the piercing of the wall structure (8) by the spring force is insufficient.

4. The method according to any one of the preceding claims, **characterized by**

   engaging a plunger (24) provided on the boom (3) with the first side (8a) of the wall structure to be pierced; and

   advancing the piercing tool (7) through the wall structure (8) only after the plunger (24) is engaged with the wall structure (8) by a pre-determined force.

5. The method according to claim 4, **characterized by**

   preventing the boom (3) from moving after the plunger (24) has been moved against the wall structure (8) by a pre-determined force.

6. The method according to any one of the preceding

claims, **characterized by**

monitoring the position between the piercing tool (7) and the wall structure (8) by at least one detector (22, 23); and

positioning the piercing tool (7) in a substantially perpendicular position to the first side (8a) of the wall structure (8) before piercing the wall structure (8).

7. A rescue boom comprising:

a movable boom (3), which comprises a proximal first end, which is connectable to a carrier (2), and a distal second end;
at least one piercing tool (7) disposed adjacent the second end of the boom (3), the piercing tool (7) being an elongated member having at least one longitudinal channel (49), the position of the piercing tool (7) with respect to the second end of the boom (3) being adjustable;
at least one feed channel (11) for feeding fire-retardant medium into the channel (49) of the piercing tool (7);
at least one nozzle (51), which is connected to the longitudinal channel (49) of the piercing tool (7) and through which the fire-retardant medium is arranged to be fed; and
at least one actuator for moving the piercing tool (7) in its longitudinal direction with respect to the second end of the boom (3),

characterized in that

the actuator comprises at least one spring (34) for providing a longitudinal impact by the piercing tool (7).

8. The rescue boom according to claim 7, **characterized in that**

the position of the piercing tool (7) with respect to the second end of the boom (3) is adjustable via means for adjusting the angular position of the piercing tool (7) with respect to the second end of the boom (3).

9. The rescue boom according to claim 7, **characterized in that**

the position of the piercing tool (7) with respect to the second end of the boom (3) is adjustable via a plurality of joints.

10. The rescue boom according to claim 7, **characterized in that**

the boom (3) further comprising: at least one detector (32; 21, 22; 23) arranged with the piercing tool (7) for monitoring the position between the piercing tool (7) and an object to be pierced.

11. A piercing device comprising:

at least one piercing tool (7), which is an elongated member comprising at least one longitudinal channel (49);
at least one feed channel (11) for feeding fire-retardant medium into the channel (49) of the piercing tool (7);
at least one nozzle (51), which is connected to the channel (49) of the piercing tool (7) and through which the fire-retardant medium is arranged to be fed;
at least one actuator for moving the piercing tool in its longitudinal direction,

characterized in that

the actuator comprises at least one spring member (34) for providing a longitudinal impact by the piercing tool (7).

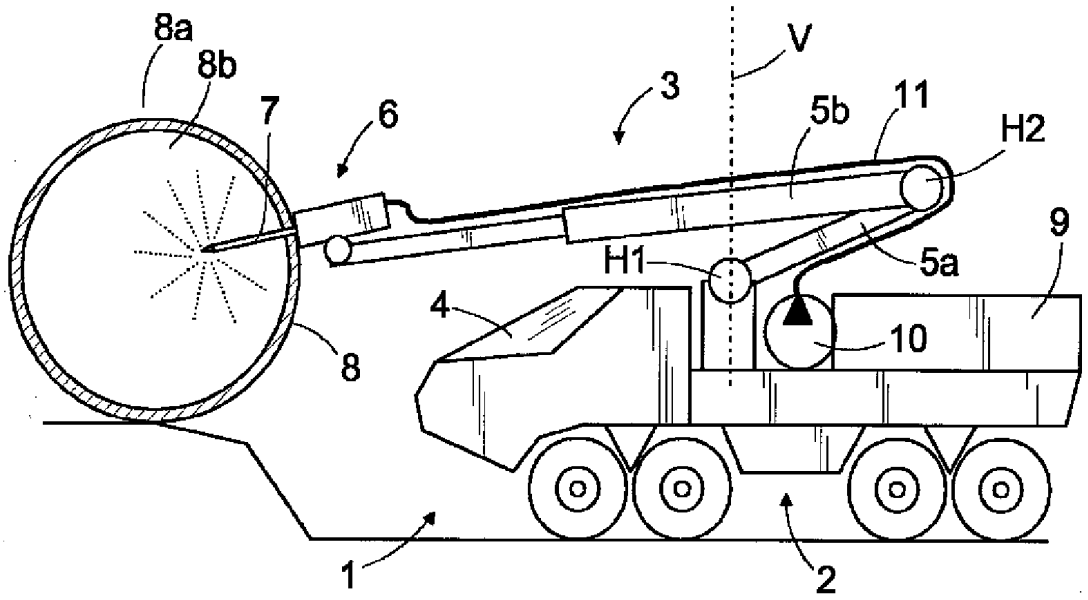

FIG. 1

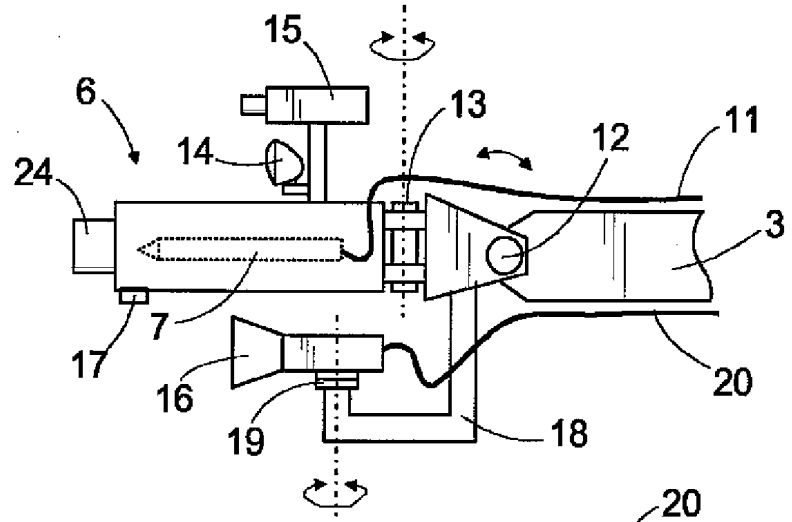

FIG. 2

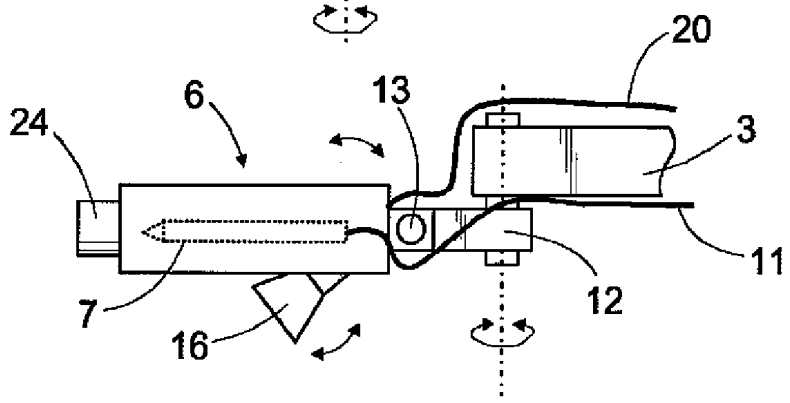

FIG. 3

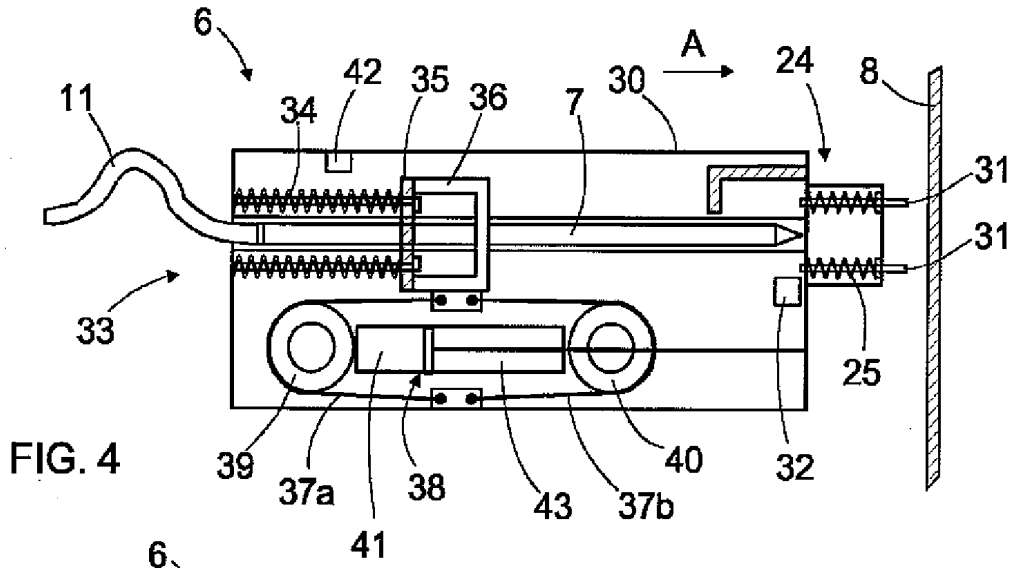

FIG. 4

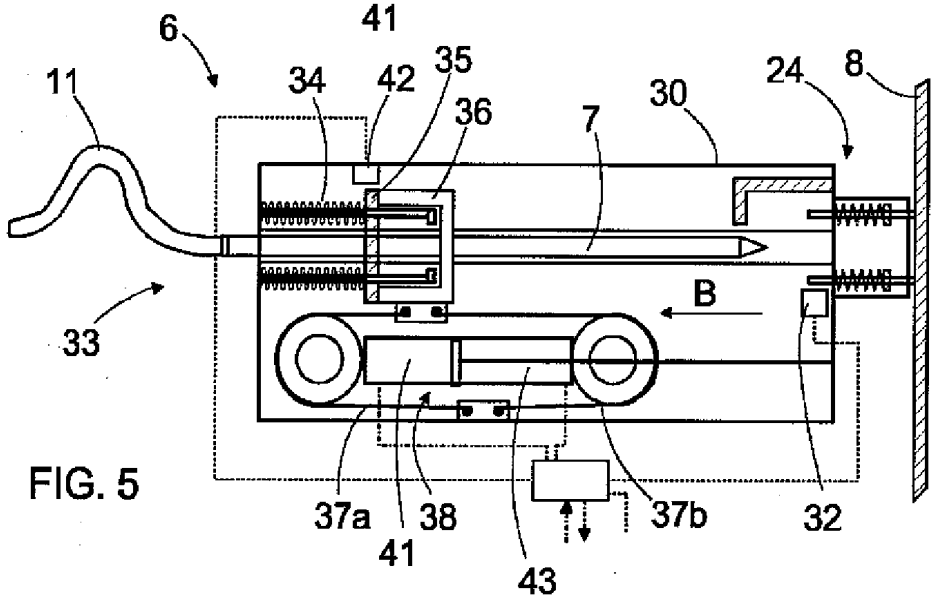

FIG. 5

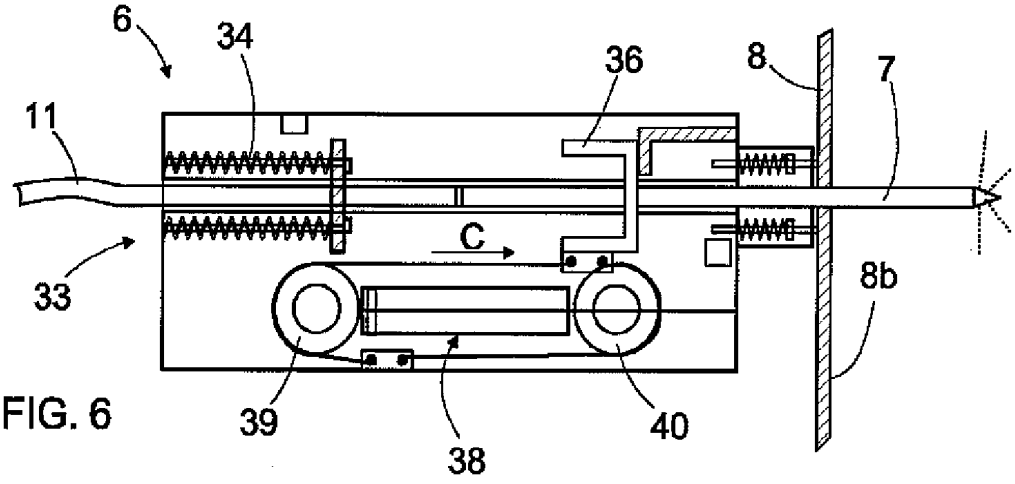

FIG. 6

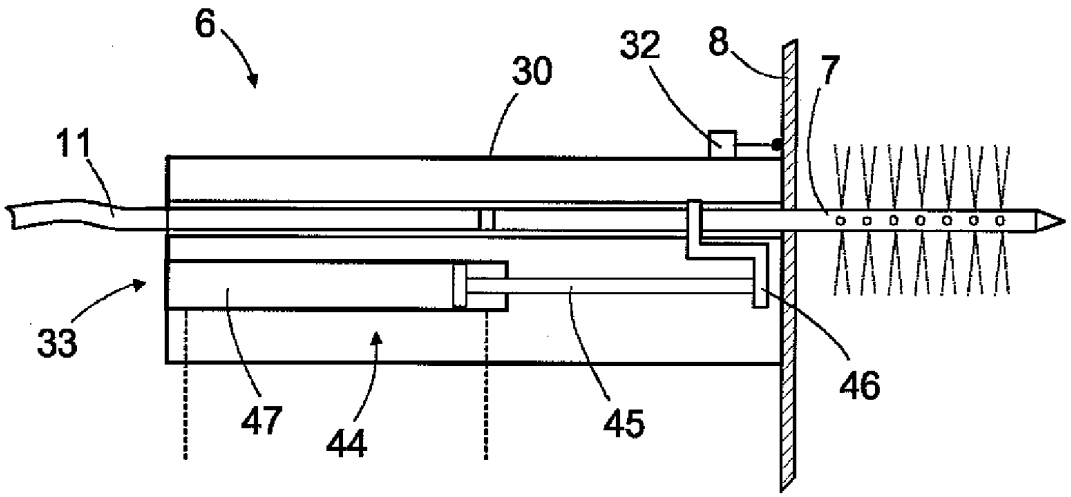

FIG. 7

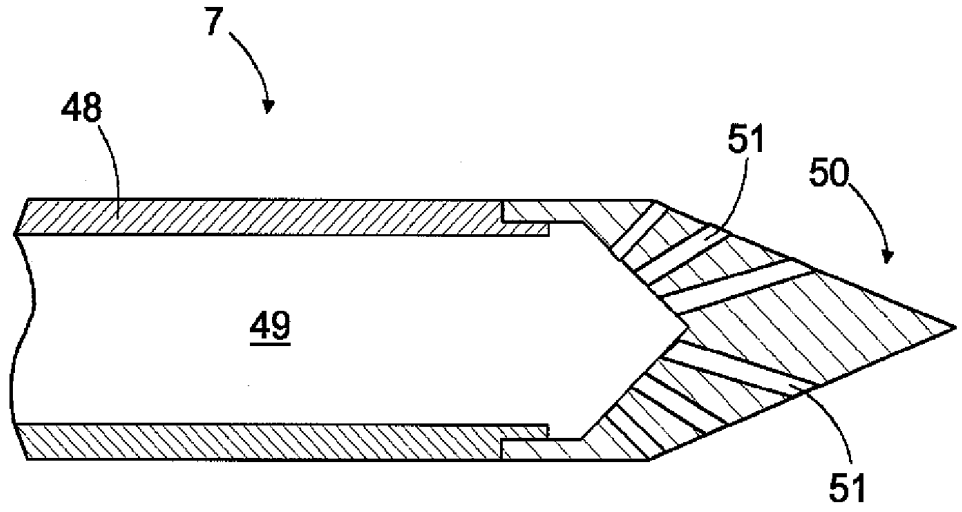

FIG. 8

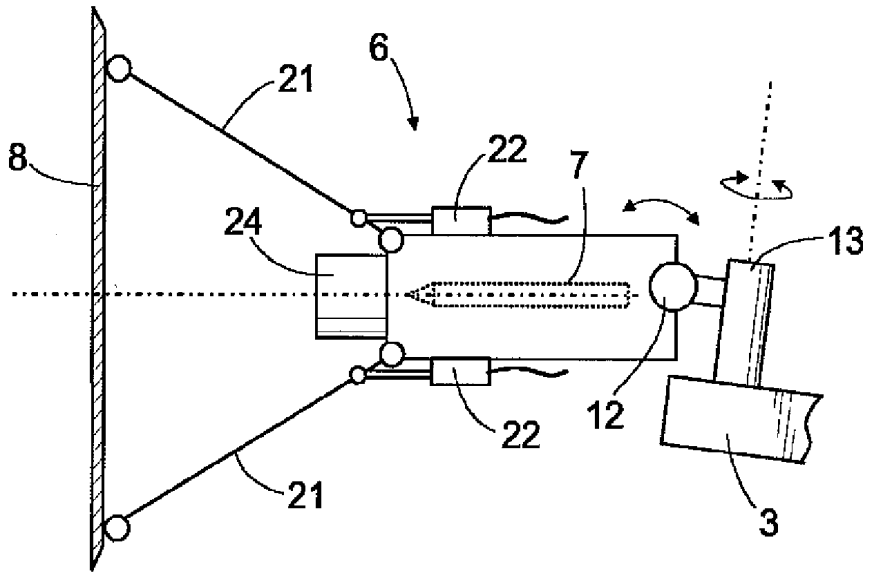

FIG. 9

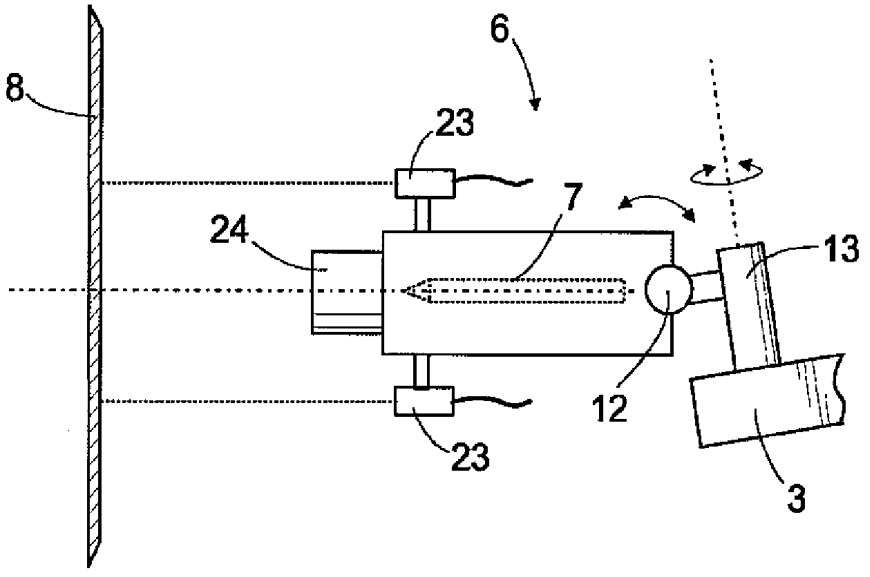

FIG. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 10 1590

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	GB 2 257 357 A (GLOSTER SARO LTD) 13 January 1993 (1993-01-13) * the whole document *	1-11	A62C27/00 A62C31/22
A	US 6 340 060 B1 (LARSSON ARNE ET AL) 22 January 2002 (2002-01-22) * the whole document *	1-11	
A	US 4 802 535 A (BAKKE ARLAN N) 7 February 1989 (1989-02-07) * the whole document *	1-11	
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

A62C
A62B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 August 2003	Neiller, F

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82